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Social Learning: Preliminary Findings of a Pilot Study

John O'Neill

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ABSTRACT

This report presents the results of a pilot study by DSTO investigating social learning at Strike Reconnaissance Group. Social learning studies the mechanisms by which knowledge and practice are transmitted across situations, posting cycles, and generations of members. A key finding is that social learning occurs differently in the aircrew world to the headquarters world due to the different nature of the work. Understanding these differences has provided new insights into the nature of work in headquarters.

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Executive Summary

JNT 98/004 C3I Social Learning Architectures is a three year research task investigating social learning. *Social learning* studies the mechanisms by which knowledge and practice are transmitted across situations, posting cycles, and generations of members.

A three month pilot study investigated and described the social learning mechanisms at Strike Reconnaissance Group (SRG). Different social learning mechanisms were identified in the aircrew world, squadron headquarters, and wing headquarters.

The key differences in these domains are:

- social learning mechanisms in the aircrew world are organised around a "body of knowledge" in the form of the aircrew categorisation scheme. Learning processes enable new members to acquire this body of knowledge, enable this "body of knowledge" to evolve, ensure that members stay current, and provide conversion programs to update an individual's knowledge from some baseline.
- social learning mechanisms in the squadron headquarters are organised around the regular interactions between aircrew members and people performing headquarters roles. People learn by interacting with, and observing the work of others. By the time an individual performs a role in the squadron headquarters, they already have some understanding of the role and do not require extensive handovers.
- social learning mechanisms in the wing headquarters are not concerned with acquiring a "body of knowledge". Instead, they are more focused on understanding how activity systems and communities inter-relate, how these relationships are sustained by the rhythm of work, and how these inter-relationships can be redefined in response to new forces. The key social learning mechanism is an individual's career trajectory that periodically returns an individual to a community enabling the individual to leverage their previous experiences and social networks.

New forces that change the work landscape at the wing headquarters are not "one-time" changes. Instead, a vision or direction is established, and the work evolves over time along a work trajectory towards this vision.

Improving social learning at the headquarters level involves:

- richer handovers that include not just the shape of the current work, but the forces that changed the shape of work, the direction the work is heading, and the current state of the work.
- organisationally defining career paths that enables people to periodically return to the headquarters environment. These career paths would enable people to understand the relationships between activity systems and develop social networks.

Understanding how the headquarter's work landscape is reshaped has shown that there are four different types of domains of knowledge. Knowledge is not only used differently in each of these types of domains, but what constitutes knowledge is different in these domains. Few practices can be expressed entirely in terms of one of these knowledge domains. Analysts need to be aware that in any practice, especially headquarters, these knowledge domains are very inter-related, complicating any observations.

The work that people perform in headquarters is a relationship between:

- the nature of the emergent situation
- the way in which Standard Operating Procedures are adapted to the situation by experienced, knowledgeable people
- the way situations are conceived is partly shaped by the work trajectory and the way work is described
- the way individual's perceive situations is partly dependent upon their career trajectories, and thus their understanding of the situation
- the work an individual performs in a situation is dependent upon the backgrounds of other people in the situation, and the resultant allocation of work across people

Changing any of these factors will change the observable work performed in a headquarters environment.

Finally, the central insights into the differences between the squadron headquarters and wing headquarters, and thus the different types of work domains, do not arise from a single, three month ethnographical study. Instead, these insights reflect seven years of observation at headquarters at all levels of command. Periodically revisiting headquarters to conduct ethnographical studies every three to five years will assist understanding not just how the headquarters works today, but how work in the headquarters evolves over time. This richer understanding will lead to more appropriate organisational memories aligned to the future needs of users in these headquarters, social learning, and more effective knowledge reuse.

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John O'Neill is a research scientist within the Information Architectures Group. He is the leader of a section responsible for researching and developing C3I Social Learning Architectures. Dr O'Neill has previously been involved in studies investigating HQAST's Functional Requirements, RAAF Command Support Systems, Movement Planning decisions support systems, as well as participating in Operational and Exercise Analysis at the various Joint Operational and Strategic level headquarters.

Contents

1. Introduction

JNT 98/004 C3I Social Learning Architectures is a three year research task investigating social learning. *Social learning* is a new program of research that studies the mechanisms by which knowledge and practice are transmitted across situations, posting cycles, and generations of members.

The central hypothesis is that social learning mechanisms are currently more effective at the tactical level than at the joint operational and strategic headquarters. An alternative way of expressing this hypothesis is that there is less "reinventing the wheel" at the tactical level compared with the joint operational and strategic headquarters. Section 2 describes the utility of social learning for the ADF.

The aim of this research is to improve social learning at the joint operational and strategic headquarters. The aim will be accomplished by:

- identifying effective social learning mechanisms at all levels in the ADF
- determining which of these social learning mechanisms are most suitable in joint operational and strategic headquarters
- introducing these social learning mechanisms into the joint operational and strategic headquarters

Possible outcomes of the social learning research include:

- more effective handover processes between posting cycles
- more integrated career management for joint positions
- development of C3ISR systems with longevity and usability beyond the initial user group, across situations and time

This report documents the preliminary findings of a pilot study into social learning. A second report titled "Social Learning: Context and Conclusions of the Pilot Study" will conduct a more detailed analysis of these findings.

The pilot study was conducted at Strike Reconnaissance Group (SRG) over a three month period. The aim of the pilot study was to test the hypothesis that there are effective social learning mechanisms at the tactical level, and to document these mechanisms. The pilot study also trialled the use of ethnographical techniques for studying social learning.

SRG has proven to be a fertile domain for studying social learning. The second section of this report introduces the concept of social learning, and why it is important for the ADF. The third section of this report documents social learning mechanisms at the tactical level in the aircrew world. The fourth section describes the social learning mechanisms employed at the squadron headquarters and why these mechanisms do not work at the wing headquarters. The fifth section of the report presents a different way of looking at the work of headquarters, makes recommendations for improving

social learning in headquarters environments, and examines the implications of reusing knowledge in different types of domains.

2. Background

This section introduces the concepts of individual learning and social learning, and then describes why social learning is important for the ADF. Finally, the organisation structure for SRG is introduced.

2.1 Individual Learning

This paper views knowledge as only existing in an individual's mind. People accumulate knowledge by learning. Learning occurs by an individual experiencing new situations, by an individual interacting with other people, or by an individual learning from artifacts created by other people such as books and other documents.

In this view, knowledge exists in an individual's mind, and information is transferred between people through the process of communication as shown in Figure 1.

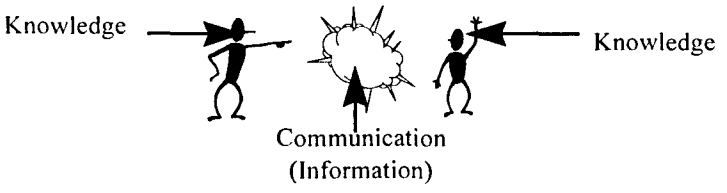

Figure 1. Knowledge versus Information

2.2 Social Learning

Social learning studies the mechanisms by which knowledge and practice are transmitted across situations, posting cycles, and generations of members.

Organisations define different ways in which social learning may occur (Lave 1988; Wenger in press):

- social learning may occur in formal courses
- social learning may occur by apprenticing new members in a community, and teaching them how to behave by "learning by doing" under the guidance of an experienced practitioner
- social learning may occur informally in conversations and story telling

2.3 Why Social Learning is of Interest to the ADF

Previous analyses conducted by DSTO in Joint Operational and Joint Strategic Headquarters have revealed the following problems with social learning:

- a common theme in exercise analyses is that some part of the planning practice is reinvented in each exercise
- the posting cycles across the three services often result in three out of four people in a functional cell in a joint headquarters being simultaneously posted, precluding the ability to apprentice new members to the work of the functional cell
- a new commander to a headquarters will often reshape the work of the headquarters, and the allocation of work across roles. One result of this reshaping and re-allocation is that it becomes difficult to learn from the experiences of previous generations of members because the work appears to be different
- whilst Command Support System tools such as JP2030's Group Enabled Meeting Support System (GEMS) (Textor and Clark 1997) have proven very effective at supporting the planning process, the information within the GEMS databases is not reused in future situations by the following generation of members

These problems can be restated in terms of Figure 1. It is often not possible to talk to another person about how work was conducted in previous situations because these people have been posted. A newcomer is often unaware of what artifacts exist, or alternatively, is overwhelmed by the magnitude of information contained by these artifacts and is unable to relate them to the work they are doing. Finally, if the shape of the work changes, it is unclear what information the previous generation of members can add that will be useful in the new way of doing things. As a result of these problems, practice is often reinvented.

2.4 SRG Organisation Structure

The SRG organisation structure is shown in Figure 2. SRG is commanded by Commander SRG (CdrSRG). CdrSRG commands one wing, 82 Wing. 82 Wing is commanded by the Officer Commanding 82 Wing (OC82Wing). OC82Wing commands two squadrons, 1 Squadron and 6 Squadron. 1 Squadron is commanded by the Commanding Officer 1 Squadron (CO1Sqn), and 6 Squadron is commanded by the Commanding Officer 6 Squadron (CO6Sqn).

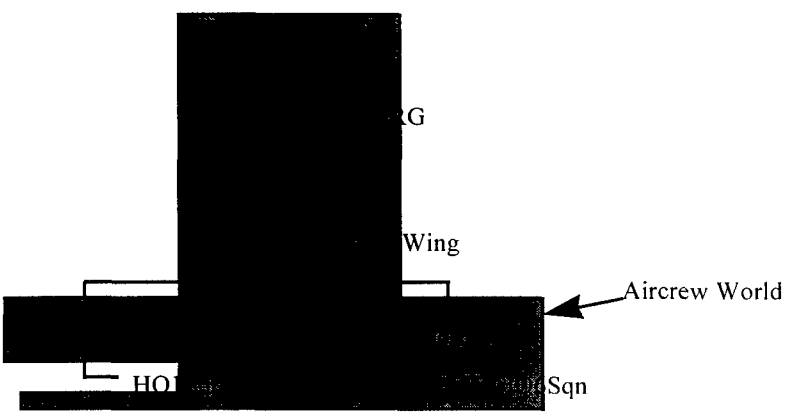

Figure 2. SRG Organisation Structure

The primary mission of SRG is to conduct strike missions. Strike missions are conducted by strike aircrew flying an F111. The strike aircrew world consists of pilots and navigators. Flying an F111 requires one pilot and one navigator. Members of the aircrew world may be in flying positions or ground jobs. The flying positions are predominantly in the squadrons. The ground jobs may be within the squadron headquarters, wing headquarters, SRG headquarters, or in other parts of the defence organisation. The strike aircrew community can be thought of as a pool of trained people that is periodically refreshed by new members every six months.

The squadron headquarter's role is to ensure that aircraft and aircrew are available at the right time and place with the required capability to conduct the mission.

The wing headquarter's role is more outward looking. The wing headquarters takes requests from outside SRG, and converts them into SRG specific information, removing much of the ambiguity and uncertainty in the process. For example, the wing headquarters may negotiate with an external agency about their requirements for a strike mission, and then send the squadron headquarters a structured description of the strike requirements for the mission in the form of an air tasking order.

The social learning pilot study focused on the aircrew world, the squadron headquarters, and the wing headquarters.

3. SRG Aircrew World

This section describes the social learning mechanisms in the SRG aircrew world. These mechanisms were identified through a combination of ethnographic observations and directed questioning. The key mechanism for maintaining practice is the *aircrew categorisation* scheme. Aircrew at each categorisation level are assumed to have a *baseline* of knowledge. The aircrew world is continually seeking to learn and evolve its practice, a key learning process is the *debriefings* held after every flight. Individual knowledge is seen to be ephemeral due to the evolving nature of the practice. Aircrew must fly regularly to maintain *currency*. When knowledge requirements change due to new systems being introduced, a *conversion program* updates the individual's knowledge from some baseline.

3.1 Aircrew Categorisation

The central mechanism for maintaining practice in the SRG aircrew community is aircrew categorisation. The *aircrew categorisation* scheme manages the current competency of aircrew, and is a training mechanism for improving aircrew competency. Aircrew competency is a reflection of an individual's understanding of three knowledge structures:

- how to operate the systems in the F111, which are expressed as Standing Instructions (SI's)
- rules and guidance

- tactics

Figure 3 shows the relationship between the three knowledge structures. SI's define what is possible, rules and guidance place boundaries on what can be done, and tactics represent how things will be done and how they may be adapted to the needs of the emergent situation.

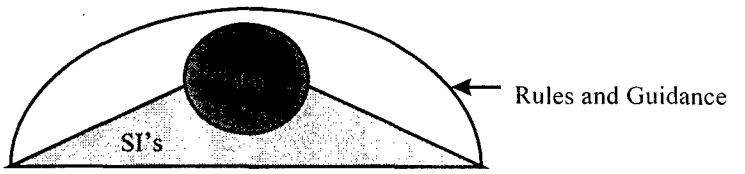

Figure 3. The relationship between the three knowledge structures

Aircrew at each categorisation level can be assumed to have a *baseline* of knowledge in each of the knowledge structures.

New members into the SRG aircrew community are "E cats". "E cats" are assumed to have no knowledge in each of the three knowledge structures. "E cats" undergo a training process to learn to fly an F111, acquiring SI knowledge and some knowledge about flying safety rules. Members who successfully complete the F111 training are posted to the squadrons as "D cats". A "D cat" undergoes training to learn how to use the F111 in combat. At this stage, the "D cat" is acquiring knowledge about the tactics, rules and guidance for being a "wingman" in a formation.

A "C cat" is combat capable, but only as part of a larger formation of F111s. A "C cat" undergoes training to learn how to lead an F111 formation and be responsible for all the F111s in the formation. The "C cat" is acquiring a deeper understanding of the tactics, rules and guidance.

A "B cat" is capable of leading a formation of F111s in combat. A "B cat" still has two further things to learn. Firstly, understanding how to lead a combat package that contains different types of aircraft performing different roles, such as fighters, strikers, electronic warfare aircraft, tankers and reconnaissance. Secondly, becoming a deep expert in all the systems on the F111. An "A cat" aircrew is quite rare, knows "everything" about F111s and is capable of leading packages in combat.

3.2 Learning

The learning processes for progressing through the aircrew categorisation scheme involves a combination of bookwork and learning by doing in the form of flying. Progression in the aircrew categorisation scheme is assessed by objective standards, for example, the ability to place a bomb within 50m of the target whilst flying in a formation and flying a particular ingress and egress route. Not all aircrew will progress through the aircrew categorisation scheme.

The three knowledge structures are not static. New knowledge is introduced into each of the different knowledge structures in different ways:

- SI knowledge only changes when the F111 is upgraded, for example, installing a new type of engine, avionics system, or weapons system. These upgrades are carefully planned and managed. Aircrew will undergo a *conversion program* that assumes a baseline of knowledge and then updates or replaces some of the models in this baseline.
- knowledge about rules and guidance is maintained through formal organisational structure. A senior officer must maintain currency in order to retain credibility in the aircrew world when issuing new rules and guidance. Section 4.2.1 reveals how these new rules and guidance arise in response to new forces.
- knowledge about tactics is continually evolving by processes internal to the aircrew world. Every flight is viewed as a learning opportunity. After every flight a *debriefing process* is conducted. The mission planning/briefing/debriefing cycle is led by the aircrew with the highest current categorisation, which is not necessarily the most senior officer. All aircrew who flew the mission participate in the debriefing process. The debriefing process examines all aspects of the mission: the planning process, briefings, the way each aircrew member performed their job, interactions between pilot and navigator, interactions between aircraft, and the execution of the objective. This forum provides an opportunity to learn from the experience of others, but it also provides an opportunity to find better ways of doing business in the form of creating new tactics.

  A key requirement in the debriefing process is finding mechanisms for converting the subjective experiences of each aircrew member into an objective view of the flight. An objective reality is constructed by using boundary objects such as video tapes from the weapon systems on the aircraft, photos of the target area, and mudmaps showing engagements at different timeslices. Since each individual will have a different subjective experience of the flight, protocols for interaction are used to keep discussions as objective as possible.

3.3 Currency

Individual knowledge is seen to be ephemeral in the aircrew world due to the continual evolution of the knowledge in the three knowledge structures. Aircrew must fly regularly to maintain *currency* and retain their categorisation, otherwise they are downgraded.

An aircrew member returning to a flying position after working in a ground job is a "D cat", they are no longer current in the tactics, rules, and guidance. However, these returning aircrew will progress from "D cat" to "C cat" more quickly than a newcomer because they simply need to update their baseline knowledge with what has changed.

There are different versions of the practice of the aircrew world held by different members of the community. These different versions result from not all members of the community having the same opportunity to stay current.

3.4 Relating the Aircrew Knowledge Structures to the Formal Organisation Structure

The key decision-makers in the aircrew world do not parallel the formal organisation structure. Senior officers will often be rated as "D cats" or "C cats" due to a lack of current flying time. The implications of this lack of currency for decision-making include:

- in the air, missions are lead by "B cats" not the most senior officer. In the aircrew world, currency is more important than rank due to the ephemeral nature of individual knowledge and the continually evolving nature of the practice.
- senior officers only retain their credibility in terms of current operations if they are willing to recognise their limitations due to a lack of flight-time and currency.
- as a result, senior officers regularly need to consult junior officers for the most current knowledge when making decisions. This includes the quite common situation where the senior officer has served in the junior officers' position at an earlier point in their career. Whilst the position may be the same, the practice and associated knowledge has changed, sometimes in a discontinuous fashion.
- senior officers do have organisational responsibilities and these are clearly expressed as rules and guidance. An aircrew member who breaks these rules and guidance will be disciplined accordingly. However, there is a large amount of trust placed in the professionalism of the aircrew, and the aircrew culture reinforces the notion of professionalism in each individual.
- there is one exception to rank losing its meaning and that is for disciplinary reasons. If an aircrew member is not performing, then that aircrew member may be assigned to fly with a senior officer on a permanent basis in order to resolve the disciplinary problem.

3.5 Discussion

The strike aircrew community highlights some of the difficulties in identifying and analysing knowledge structures in an organisation for the following reasons:

- some knowledge, such as SI's, can be viewed as objective, decontextualised knowledge that an individual can be assessed to either possess or not possess, and is suitable for elicitation by traditional knowledge acquisition techniques
- some knowledge, such as tactics, is continually being adapted and improvised as people cope with emergent situations.
- some knowledge is constructed by using boundary objects as containers for mapping across different individual's subjective experiences in a situation, for example, debriefing after a mission. These debriefing situations involve examining the *relationships* between an individual and their fellow aircrew member in the aircraft, with the aircraft, with the target, with other aircraft in the formation, and with other incidents that occurred during the mission such as being attacked by enemy aircraft.

- some knowledge is related to the formal organisation structure, such as the formal mission tasking orders, whereas other knowledge is held by the community, for example, the aircrew categorisation scheme.
- the focus of the community is not just in producing and using knowledge, but also in maintaining the knowledge base and updating the knowledge base by training new members and learning from each piece of work.
- the continual evolution of knowledge means that many versions of the knowledge exist within the community. An individual's currency plays an important role in deciding who has a voice in the decision-making process.

4. Headquarters World

This section identifies social learning mechanisms used by aircrew members in a squadron headquarters and in a wing headquarters. These mechanisms were identified through a combination of ethnographic observations and directed questioning.

4.1 Squadron Headquarters

When aircrew are not flying, they perform other ground-based duties. The key social learning mechanisms of aircrew in a squadron headquarters are *legitimate peripheral participation* and an individual's *career trajectory*.

4.1.1 Legitimate Peripheral Participation

Aircrew do not get to fly all the time. When aircrew are not flying, they perform a range of secondary duties in the squadron headquarters. These secondary duties include producing the flying program and maintaining aircrew categorisation statistics. A secondary duty is performed for six months before the individual rotates to another secondary duty.

A puzzling aspect of secondary duty work is that the incoming aircrew member is simply given the "gen", a folder of current issues and contact numbers, and is expected to be productive immediately. Consider the secondary duty of producing and maintaining the flying program. Producing the flying program involves determining which flights to schedule for the following period. This activity is constrained by factors including the exercise program, training requirements for upcoming exercises, maintaining aircrew currency, project upgrades and conversion courses, and aircraft serviceability. The secondary duty of maintaining the flying program is made even more difficult with events like an aircraft going unserviceable just before a mission, or an aircrew member being taken ill. Where does the individual obtain the knowledge to deal with these situations?

Understanding how an individual "knows" how to perform these secondary duties requires a reappraisal of the work of an aircrew member. Aircrew interact with each of

the secondary duty roles on a regular basis to fly on missions. For example, aircrew interact with the person performing the flying program role to find out when they will be flying next week, which aircraft they will be flying today, and the purpose of the flight. Over time, the aircrew members will have opportunities to witness how people performing the secondary duty role deal with problematic situations. For example, it may be the aircrew member's aircraft that becomes unserviceable, and the aircrew member will witness the interaction between the flying program role and the engineering officer as they resolve the situation.

Learning about the work of others through peripheral interaction is termed *legitimate peripheral participation* (Lave and Wenger 1991). Through the process of legitimate peripheral participation, an individual is assumed to have developed a baseline of knowledge about the routine work of the role.

It is not assumed that the individual understands all aspects of the work landscape of the role. The "gen" folder is one mechanism for expanding this partial space by revealing the informal social network by which work gets done, and the set of current issues. A second way of expanding this partial space is by listening to stories told by other people who draw on relevant experiences. For example, listening to stories about how we conducted training last year in a particular manner for these reasons, and the year before in a different way again. The aim of story-telling is to provide the individual with a larger space for exploring possible options. More importantly, the individual has the opportunity to adapt and improvise the work landscape of the role in emergent situations and not be limited by their initial, partial understanding.

4.1.2 Career Trajectory

A second puzzling aspect about the work conducted in a squadron headquarters is how an individual learns to be a Commanding Officer (CO). Responses to interview questions often state that by the time a person reaches the CO position they "should know how to be a CO", and that any handover process basically updates them on current issues.

How does an individual "know how to be a CO"? Trying to elicit this information through either direct questioning or observation is not immediately helpful. The C2 literature (Andriole and Halpin 1991) is full of analyses of the work of a commander in terms of tasks, information, decisions, leadership style, group dynamics, individual cognitive style, and so on. Whilst these analyses reveal something about an individual's current behaviour, they do not reveal how an individual learnt to be a commander in the first place.

An alternative approach to understanding how an individual "knows how to be a CO" is not to focus on what the individual is currently doing, but instead to focus on what they have done. An individual's *career trajectory* is simply a description of the roles an individual has performed in their career. One example is shown in Figure 4. In this example, an individual enters the strike aircrew community and is trained as a pilot in

the squadron. The individual is then posted as a Qualified Flying Instructor (QFI). The individual's next posting returns them to the squadron in a flying job as a flight commander. The individual is then posted to the wing headquarters as an Executive Officer (XO). At this stage of their career, the individual is posted to staff college where they undergo formal training to become a commander, and have the opportunity to interact informally with their peers. Finally, the individual is appointed to the CO's position in the squadron.

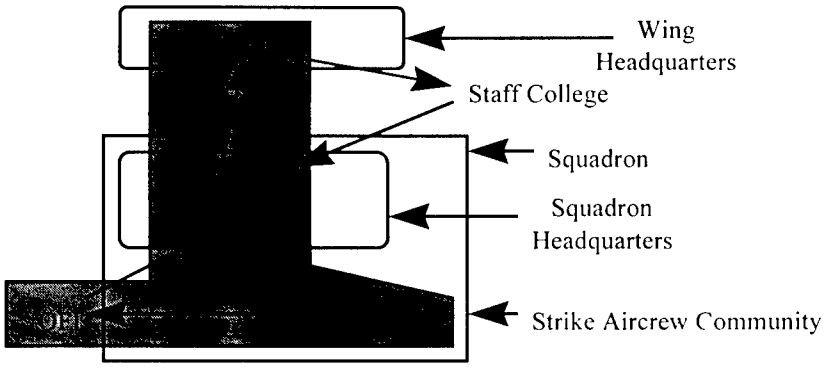

Figure 4. Career trajectory diagram

Each of these positions can be viewed as opportunities for legitimate peripheral participation, instead of the more traditional view of a role as developing skills in a particular work landscape. Viewing the roles as opportunities for legitimate peripheral participation reveals that an individual has many opportunities to view different people performing the CO role from within a squadron. The staff job in the wing headquarters provides a further opportunity to view the CO's role from an external perspective. Viewing how the CO role is performed by different people from both within and external to the squadron, provides the opportunity for an individual to understand the nature of the work, and command strategies that do and do not work.

4.2 Wing Headquarters

The social learning mechanisms of legitimate peripheral participation and career trajectory that work so well at the squadron headquarters are inadequate at the wing headquarters. This is due to the differences in the nature of interactions in these headquarters. The aircrew regularly interact with the secondary duty roles in the squadron headquarters enabling legitimate peripheral participation. However, aircrew interact with the roles in the wing headquarters on a more irregular basis, reducing the opportunities for legitimate peripheral participation.

Describing the work of a wing headquarters reveals the underlying notion of *work trajectories*. Examining work trajectories reveals that new external *forces* will result in the establishment of new work trajectories that change the *work landscape* of the headquarters practice. A major source of new external forces is the appointment of a new commander. Based on an understanding of these work trajectories and where

they come from, recommendations are made for improving social learning in a wing headquarters environment.

The description of the work of a wing headquarters has changed over time. In 1993, the work of a wing headquarters could be described as "air tasking". In 1998, the work of a wing headquarters at SRG could be described as "mission tasking", "project management", and "document management". Whilst the roles within the wing headquarters have the same names as in 1993, the tasks performed by each role have changed quite significantly.

Understanding the nature of social learning at the wing headquarters first requires understanding the work landscape and why description of this work landscape have changed so much. The second aspect involves understanding the relationship between an individual's career trajectory and this changing work landscape.

4.2.1 Work Landscape

Describing the work landscape of the wing headquarters in 1993 as "air tasking" was essentially describing the work at a point in time. Understanding how the work landscape changed requires understanding the *forces* that reshaped this landscape.

Since 1993 there have been three major forces reshaping the work landscape of the wing headquarters:

- **flying safety**. A series of accidents in the RAAF led to an increasing formal emphasis being placed on flying safety. An important legalistic factor in flying safety is ensuring that all the procedures are up-to-date. Thus, the wing headquarters assumed responsibility for document management.
- **project management**. There are currently 22 projects underway in a mid-life upgrade to the F111s. Each of these projects is quite substantial, for example, converting the F111 from an analogue aircraft to a digital aircraft, new engines, and new weapon systems. The wing headquarters has taken responsibility to ensure that the whole aircraft fleet is upgraded in a timely manner, and the operational objectives can still be met whilst the upgrades are occurring.
- **interoperability with the US**. SRG believes that any future coalition operation Australian is likely to be involved in will require interoperability with the US. To simplify this process, SRG has taken the USAF's mission tasking process and adapted it to SRG's requirements. By adopting a mission tasking perspective, the basic unit of work has changed in the headquarters from a task for each mission to tasking all the missions for the following day.

Some of the forces are external to SRG such as flying safety and project management, other forces are internal and are introduced by new commanders, such as interoperability with the US.

Closer examination of these forces reveals that each force does not result in a one time change to the work landscape. Instead, a direction or vision is established, and the

work evolves towards this vision along a *work trajectory*. For example, the new force of "interoperability with the US" resulted in a vision of a mission planning cell in the wing headquarters. The work trajectory for establishing a mission planning cell involved establishing a "mission director" role in the wing headquarters. In 1997, the work of the mission director role was largely administrative. In 1998, the mission director role was more involved with the actual execution of the mission. In the future, the work of the mission director role will be more holistic covering both the planning and execution of the mission. The changing work landscape is shown in Figure 5.

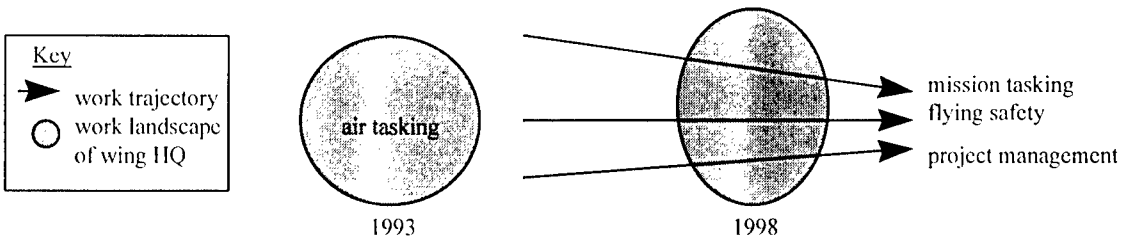

Figure 5. The changing work landscape

The forces themselves are changeable in nature. Some forces will be seen through to completion. Other forces will slowly disperse. Some forces will be reconstituted in a different form. In the headquarters environment, a new commander is a major source of change to the set of extant forces. A new commander may introduce new forces, and downplay others. Commanders will also need to be responsive to externally imposed forces, such as flying safety. Figure 6 shows how the work if the wing headquarters may change hypothetically by 2003.

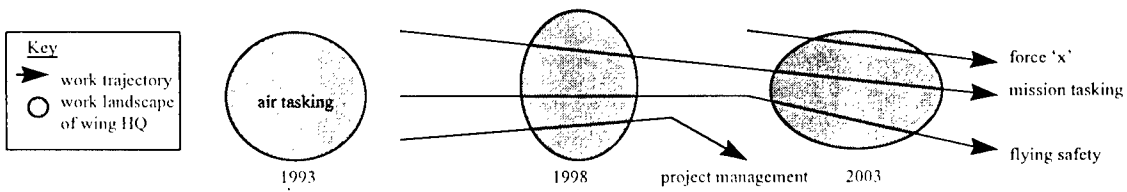

Figure 6. Hypothesising the work landscape in the future

Figure 6 shows how some forces have dispersed (project management), new forces have arisen (force 'x'), some forces have continued (mission tasking), and some forces have been reinterpreted with new descriptions (flying safety).

4.2.2 Individual Career Trajectory

Unlike the aircrew world and squadron headquarters, it is no longer possible to assume that a newcomer has a current baseline of knowledge for performing a role in this changing work landscape. The aircrew world and squadron headquarters can draw on a pool of trained people, and therefore assume that a newcomer has a baseline of knowledge. The aircrew world actively trains people through the aircrew

categorisation scheme. The squadron headquarters accesses a pool that has been "trained" through the process of legitimate peripheral participation with the secondary roles on a daily basis.

The wing headquarters does not have access to a pool of people who understand the wing headquarters work landscape. Whilst aircrew have day-to-day interactions with the squadron headquarters, their interactions with the wing headquarters are far less frequent, reducing the opportunities for learning by legitimate peripheral participation.

Allocating tasks to each role within the wing headquarters is at least partially dependent upon an individual's previous experience. A re-examination of an individual's career trajectory and the *balance* in the headquarters will explain this phenomenon.

For non-aircrew members, the ideal career trajectory is shown in Figure 7. This career trajectory involves being trained in a discipline (for example, logistics, intelligence etc), serving a posting at a squadron headquarters, being posted elsewhere, then being posted into the wing headquarters. The benefits of this career trajectory is that it enables an individual to:

- develop competency in a functional area
- gain knowledge of SRG through a posting at the squadron headquarters
- learn through legitimate peripheral participation how another person handles the role in the wing headquarters

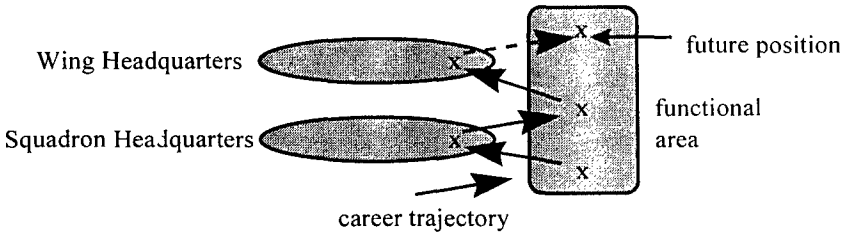

Figure 7. Career Trajectory

From anecdotal evidence, individuals who have followed this career trajectory are productive at the wing headquarters within a month of starting. Individuals who have not followed this career trajectory, in particular serving at the squadron headquarters before serving at the wing headquarters, are often struggling six months into their posting at the wing headquarters.

Allocating tasks to roles in the wing headquarters is partly dependent on an individual's career trajectory, the collective tacit knowledge of the staff in the wing headquarters, each individual's current experience in the wing headquarters, and partly dependent upon each individual's future career trajectory.

There are some tasks that require an aircrew background, and can only be assigned to people from that background. Other tasks are best handled by people with experience in a particular community of practice, for example, issues arising from project work are best handled by people who have worked on that project on a previous posting.

5. Discussion

5.1 Rethinking the Work of a Headquarters

A military headquarters is an arena that enables people from different activity systems, or communities of practice, to collaboratively frame and solve problems in an ever changing work landscape. The work of a headquarters is mainly informal in nature and results in the *realignment* of activity systems in response to new forces, reinterpretation of existing forces, or the needs of emerging situations. A major feature of this realignment process is ensuring that the rhythm of work is maintained. The rhythm of work is mediated by a timeline that ensures that all players (both within and external to the headquarters) get sufficient time to do their work. The adaptability and flexibility of a headquarters arises from the ability to reallocate tasks across roles in response to new forces, and adapt doctrine in emergent situations.

Whilst there are a number of enduring generic features in headquarters such as the functional areas, the roles, and the planning process, the actual practice is more dependent on the following dimensions: organisation perspective, role perspective, community perspective, individual perspective, practice perspective, and balance.

The **organisational perspective** can be viewed as the forces that shape the work landscape and the trajectory of work as shown in Figure 8.

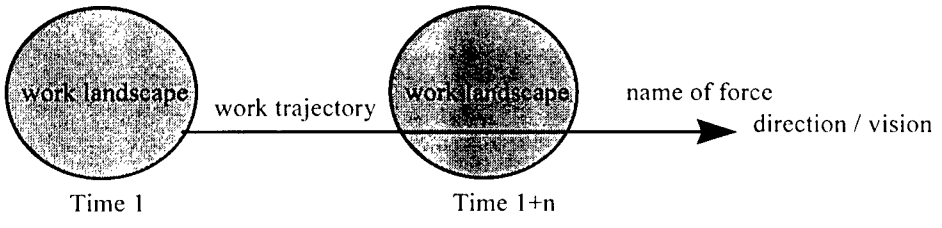

Figure 8. How forces change the work landscape

The **role perspective** views roles are dynamic, fluid phenomena that change their shape due to new forces, the needs of emergent situations, and the different individuals performing the role. Roles are only fixed, unitary phenomena that can be analysed in terms of tasks, information and decisions if they are viewed at a single point in time.

A **community perspective** needs to address the lack of access to a pool of trained people for the headquarters. An alternative approach to providing a pool of trained

people is to ensure *continuity* of membership of the headquarters community over time. Continuity is achieved by interweaving postings in the headquarters environment with postings outside this environment.

Managing the interweaving of postings from an organisational perspective is accomplished by defining career paths. A career path is simply a sequence of positions in an organisation that builds upon, and develops, a person's capability over time. Career paths describe the accumulation of knowledge and experience that the organisation believes an individual requires to perform each position, and progress along the career path. The organisation is thus seeking to ensure that there is a supply of trained people who can fill the positions in the future.

Each individual develops a specialisation (such as aircrew) and a sub-specialisation (such as projects). The sub-specialisation is a different worldview that recognises need to liaise with other communities.

An individual's career trajectory is thus an interweaving between the specialisation and sub-specialisation career paths as the individual works in different positions in the organisation. The posting cycle is the mechanism for managing this interweaving.

Defining career paths where people return to a community at different points in their career is one way of ensuring continuity of staff over time. Even though staff will be posted in and out of the community, there is a large enough body of staff to ensure continuity and the evolution of the practice.

An **individual perspective** views an individual's career trajectory as an important driver for working in a headquarters. An individual's career trajectory provides the following dimensions:

- where they've been, what roles they have served in, what situations they've experienced
- the social networks they have established
- the areas they are current in, and how they can leverage their social networks for areas they are not current
- the opportunities for legitimate peripheral participation, not just in terms of their career path, but other work occurring in the same physical proximity
- where they are going, and spending time developing themselves for future positions through courses, legitimate peripheral participation, and developing social networks

A **practice perspective** reveals that generic products have a different role in an ever-changing work landscape. Generic products such as doctrine and procedures are no longer prescriptions for action. Instead, these generic products are used to first orient people in a situation, then people interpret, improvise, and adapt these products to the needs of the situation.

Newcomers without experience in using the generic products find it difficult to adapt them to the new situation, and tend to reinvent something situation-specific. Whilst this approach is successful for the immediate task, it means that the generic products must be reinvented for each situation which is costly, time-consuming and fails to learn from the past.

Being able to effectively use the generic products requires experienced, knowledgeable people. The career path approach of regularly posting people back into a community helps develop and maintain this experience over time.

The need to assess the collective tacit knowledge and determine the **balance** of the headquarters staff has two causes: lack of continuity of the headquarters community and the impact of external forces.

The lack of continuity of the headquarters community is most evident in the current practice of employing reservists in roles previously performed by aircrew. Since the reservists do not have career trajectories that includes aircrew experience, this has caused a reallocation of tasks across roles.

An idealised world would involve developing continuity in the headquarters community and appointing people to positions who have the appropriate career trajectory. The underlying aim would be for the community to take responsibility for maintaining and improving the planning practice in a similar fashion to the aircrew world being responsible for the aircrew categorisation scheme. In this manner, new commanders would not be able to simply reorganise the planning practice. Instead, the planning practice would be adapted by the community to new forces including those introduced by the new commander.

If the headquarters community is to maintain the planning practice, this will require developing trust between the commander and planning staff, and developing active learning through internal assessment. Developing trust will be facilitated by ensuring continuity of membership to the headquarters community over time, and all members recognising the areas they are, and are not, current. Active learning must be made part of the planning timeline for headquarters work, just like aircrew debriefs are incorporated into the planning timeline for the aircrew community.

The one area that could change is the form of the boundary object produced by the planning practice for the commander. For example, a new commander may prefer information presented as graphics instead of text. It should be noted that changing the boundary objects simply changes the interface between the planning practice and the commander, not the practice itself.

The impact of external forces will affect the balance of the headquarters, and the allocation of tasks across roles. Work will be allocated in terms of the individuals with the most relevant prior experience for dealing with these external forces. The adaptability and flexibility for coping with external forces by reallocating tasks across

roles is a key feature of SRG's ability to cope with new forces and the needs of emergent situations.

5.2 Rethinking Social Learning

The social learning mechanisms at the headquarters level have a personal dimension, an organisational dimension, and a work dimension.

Personal Dimension
When a new staff member is posted into a headquarters there are a number of factors that need to be addressed including: handovers and career trajectory.

The handover process for secondary duties involved passing on the "gen" folder from the previous person containing the current issues and contacts. However, this handover process assumes a baseline of knowledge.

The changing nature of the work landscape for headquarters work requires a different approach to handovers. Instead of just handing over the current situation, the previous person should also provide some explanation as to how the work landscape has changed. A richer handover would include:

- a description of the work landscape when the incumbent started (define a starting model for people to relate to)
- a description of the forces that have changed the shape of the work
- a description of the work trajectory and the direction the work trajectory is heading (the vision)
- a description of the current state of the work (how far has it gone along the trajectory)
- a description of the current issues and contact phone numbers (the "gen")

Richer handovers in this form would package the work in a way that enables other people to understand how and why the work has evolved. This package provides a richer base for newcomers to continue moving the work forward, rather than simply reinventing the work.

Organisational Dimension
Interweaving career paths that move people in and out of a community is one mechanism for ensuring continuity. The advantages of interweaving career paths as a social learning mechanism include:

- some continuity of membership across time
- corporate knowledge is retained in the form of people's tacit knowledge and contribute those experiences to the current work, rather than reinventing everything from scratch. Contributions from past experiences can be made in the form of analogies, stories, and patterns.
- from anecdotal evidence, people are productive more quickly when posted into new positions

Career paths are an idealisation of how people should be developed within an organisation, and how positions should be staffed. A pragmatic approach is that career trajectories will not always provide the appropriate people due to staff turnover, crisis situations, downsizing etc. Rather than leaving the individual to flounder (or reinvent the wheel), the community should take some responsibility for engaging the individual in the work landscape by:

- identifying deficiencies in their background knowledge / social networks from the individual's career trajectory. For each of these deficiencies, provide the individual with the opportunity to work in areas that address these deficiencies. For example, if a newcomer to the wing headquarters has not worked at the squadron headquarters, provide an opportunity for the individual to spend some time at the squadron headquarters seeing the work.
- closely mentoring the newcomer. The newcomer should be closely mentored by someone who understands the practice. Ideally, the newcomer should be in the same physical space as the mentor to facilitate discussions. For example, when the newcomer views the work of the squadron headquarters, the mentor should discuss this work and the relationship to the work of the wing headquarters.
- discussing the importance of the timeline for establishing the rhythm of work, aligning work across activity systems, and understanding the implications when deadlines are missed for the work of other people in other activity systems
- the newcomer should be involved in the work of the headquarters immediately, especially exercises
- the richer handovers still have value, but need interpretation by the mentor, and probably need revisiting after the newcomer has worked in the area for a month

The community requires a tracking system that provides the ability to find all its members, including those members who are currently posted outside the community. The value of this system is that it is much simpler to have a conversation with the projects with someone who came from the F111 world than someone who has no experience of F111s.

Work Dimension
SRG has been actively working to reduce the size of "one-off" type tasks so they can be accomplished by an individual within a single posting, negating the need for social learning. The best example involves the mid-life projects updating the F111s where SRG has F111 aircrew posted into the project world with the aim of developing the new SI's which they will bring back to the aircrew world on their next posting, dramatically reducing the conversion time.

5.3 Rethinking Knowledge Reuse

The case studies have shown how the way work is perceived changes the way knowledge is reused. Four different ways of perceiving work and reusing knowledge have been identified: routine work, situated action, legitimate peripheral participation, and boundary transcending. These four different ways of perceiving work and reusing knowledge can be drawn on a continuum as shown in Figure 9. The discontinuity on

the continuum indicates that the knowledge structures undergo discontinuous change. The left-hand side of the discontinuity reflects the importance of the "know-what" and "know-how" knowledge structures. The right-hand side of the discontinuity reflects the importance of "know-when", the rhythm of work, and how the relationships between activity systems can be reconceived, creating a new rhythm of work. The characteristics of these four different ways of perceiving work are described below.

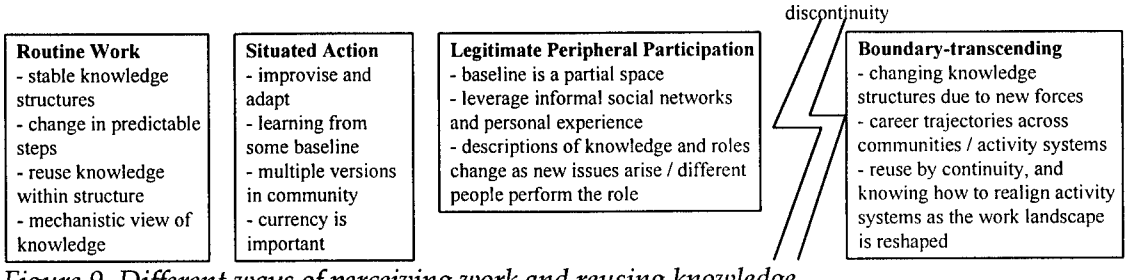

Figure 9. Different ways of perceiving work and reusing knowledge

Routine Work is characterised as domains of knowledge where the knowledge structures are relatively stable, and change only occurs in predictable steps, for example, the SI knowledge in the aircrew domain. Knowledge reuse occurs by reusing the knowledge within these knowledge structures across situations. This view of knowledge is very mechanistic in nature.

Situated Action is characterised by people improvising and adapting knowledge within the knowledge structures. Learning occurs by assuming that each individual has a baseline of knowledge, and that a combination of formal coursework and learning by doing can bring the individual up-to-date. In professional areas such as the strike aircrew community, the knowledge is maintained by the community, not by the formal organisation structure. The implications of this approach is that multiple versions of knowledge will exist in the community as not all members will have the opportunity to stay up-to-date. As a consequence, currency is an important issue in deciding who has a legitimate voice in decision-making.

Legitimate Peripheral Participation is characterised by people developing a baseline of knowledge that only ever represents a partial space of the work other people are actually doing. The partial space is expanded by leveraging informal social networks, personal experience, and the experiences of others in the form of stories. The partial space will thus be expanded in different ways by different people as they cope with new issues. As a consequence, descriptions of the knowledge required to perform the role, and descriptions of the duty statement for the role will continually evolve.

Boundary Transcending is characterised by reshaping the work landscape by redefining the boundaries in response to new forces. A consequence of redefining the boundaries is that the knowledge structures will be reconceived, often in very different forms. Career trajectories for an individual will cross communities and activity systems as individual learn about how the different activity systems are inter-related. The key mechanisms for reusing knowledge include providing continuity of membership to the community by having people return to the community on alternate

postings. The types of knowledge reused include: knowledge about how activity systems are aligned and realigned, the boundary objects that are constructed to enable this realignment, the rhythm of work that enables this realignment, the generative metaphors underlying this realignment, and the stories associated with successful and unsuccessful realignments.

Boundary transcending's role of reshaping the work landscape underpins the activities of routine work, situated action and legitimate peripheral participation as shown in Figure 10.

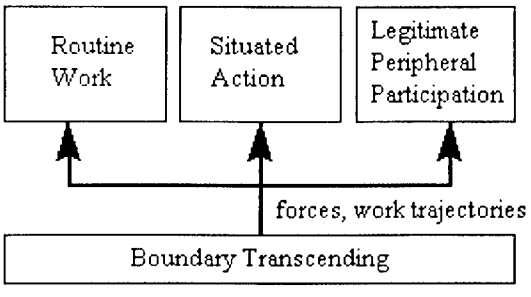

Figure 10. The central role of boundary transcending

Few practices can be expressed entirely in terms of one of these four ways of perceiving work. For example, in a wing headquarters there are knowledge-based tools that support the routine work such as weaponeering; the planning practice is continually evolving and can be expressed as situated action; the way new generations of members perform roles in the headquarters is continually being redefined as a result of legitimate peripheral participation; and the senior officers are continually looking for new forces that may reshape the work landscape in a boundary transcending activity.

5.4 The Invisible Structures that Constrain the Observable Work

Investigating these social learning mechanisms reveals that understanding the practice at any level in the ADF has the following dimensions as shown in Figure 11:

- the nature of the emergent situation
- the way in which SOPs are adapted to the situation by experienced, knowledgeable people
- the way situations are conceived is partly shaped by the work trajectory and the way work is described
- the way individual's perceive situations is partly dependent upon their career trajectories, and thus their understanding of the situation
- the work an individual performs in a situation is dependent upon the backgrounds of other people in the situation

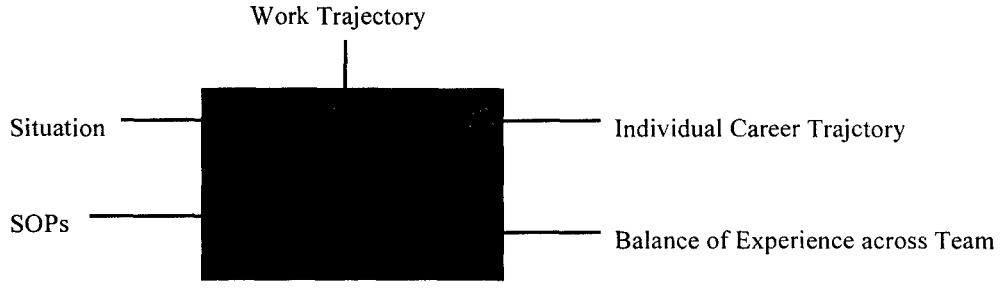

Figure 11. Factors in determining what work is performed

6. Summary of Social Learning Mechanisms

The key social learning mechanisms in the aircrew world are:

- the aircrew categorisation scheme
- the assumption that aircrew have a baseline of knowledge at each level of the aircrew categorisation scheme
- the learning processes of:
    - formal coursework
    - learning by doing (flying)
    - debriefings - assessment conducted internally by the aircrew community after every flight
    - conversion programs to update individual knowledge from some baseline
- currency, and the importance of social networks to access those who are most current

The key social learning mechanisms in the squadron headquarters are:

- legitimate peripheral participation
- career trajectory within the aircrew world

The key social learning mechanisms in the wing headquarters are:

- individual career trajectories that cross communities and activity systems,
- organisationally designing these career paths so that individuals periodically returns to each of these communities
- individuals knowing what they are, and are not, current in
- individuals leveraging the social networks developed during their career for areas they are no longer current

7. Conclusions

The central hypothesis behind social learning is valid. Social learning is effective at the tactical level. The pilot study at SRG has identified a range of social learning mechanisms in the aircrew world, squadron headquarters, and wing headquarters.

Studying the social learning mechanisms at the wing headquarters has revealed that the nature of headquarters work is very different to work in the aircrew world. The headquarter's work landscape is continually being reshaped by new forces.

Understanding how the headquarter's work landscape is reshaped has shown that there are four different types of domains of knowledge, routine work, situated action, legitimate peripheral participation, and boundary-transcending. Knowledge is not only used differently in each of these types of domains, but what constitutes knowledge is different in these domains.

Few practices can be expressed entirely in terms of one of these knowledge domains. Analysts need to be aware that in any practice, especially headquarters, these knowledge domains are very inter-related, complicating any observations.

Observations of headquarters work is further complicated by many of the structures being invisible to immediate analysis. The inter-related factors that shape the observable work of a headquarters at a particular point in time include:

- the emergent situation
- the adaptation of SOPs and doctrine
- the forces and work trajectories shaping the work landscape
- the individual's career trajectory, how this shapes their perception of the situation, and how this shapes their behaviour in the situation
- the collective experience of the staff working in the situation, and hence the allocation of tasks

Finally, the central insights into the differences between the squadron headquarters and wing headquarters, and thus the different types of work domains, do not arise from a single, three month ethnographical study. Instead, these insights reflect seven years of observation at headquarters at all levels of command. Periodically revisiting headquarters to conduct ethnographical studies every three to five years will assist understanding not just how the headquarters works today, but how work in the headquarters evolves over time. This richer understanding will lead to more appropriate organisational memories aligned to the future needs of users in these headquarters, social learning, and more effective knowledge reuse.

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19. ABSTRACT

This report presents the results of a pilot study by DSTO investigating social learning at Strike Reconnaissance Group. Social learning studies the mechanisms by which knowledge and practice are transmitted across situations, posting cycles, and generations of members. A key finding is that social learning occurs differently in the aircrew world to the headquarters world due to the different nature of the work. Understanding these differences has provided new insights into the nature of work in headquarters.